

Status of the GERB data processing system at launch

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Content

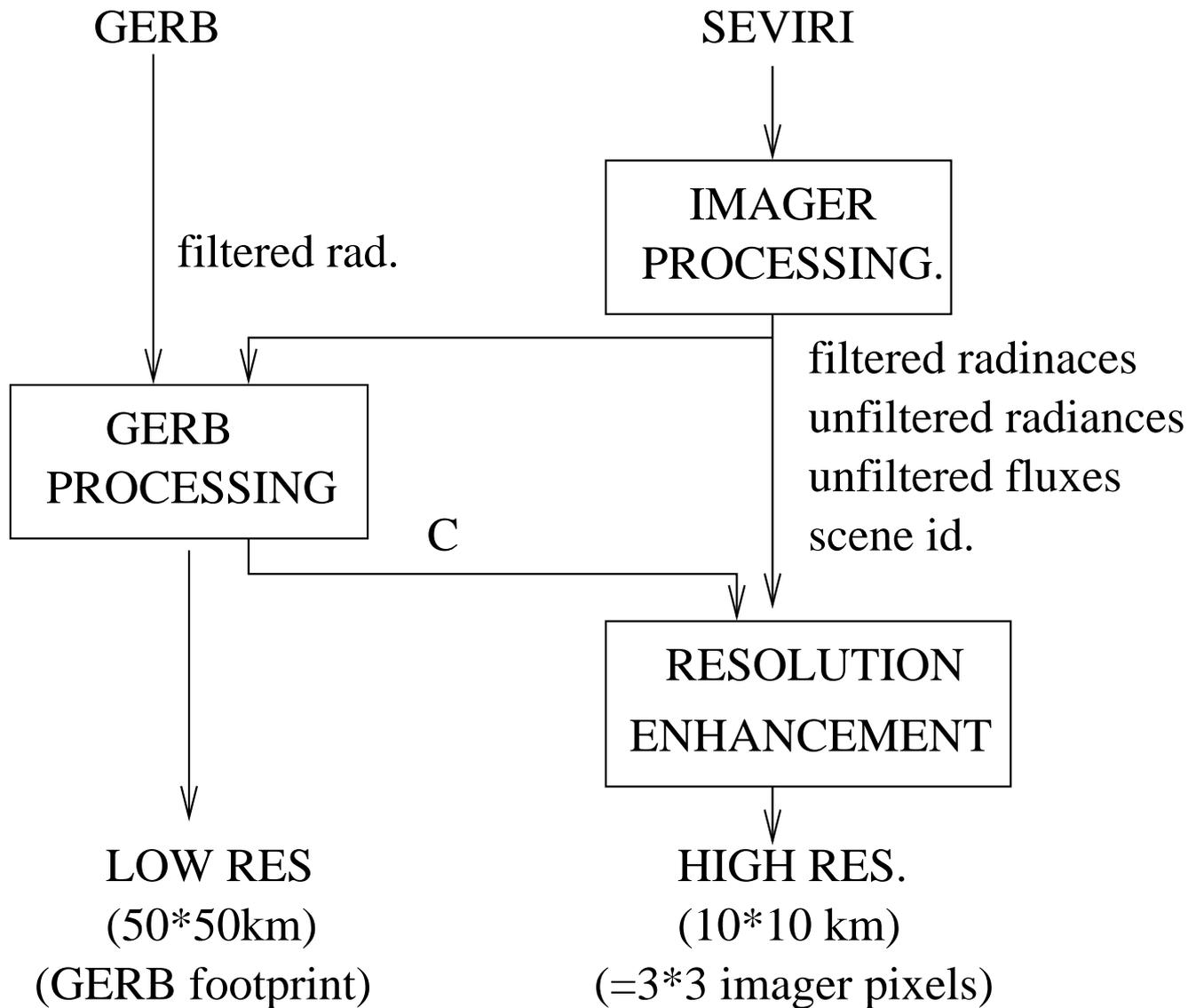
Overview of the (first version of the) processing system that will be used to process in near real time the GERB data.

- Instrument data unfiltering,
- Scene identification,
- Radiance-to-flux,
- Resolution enhancement.

Note: the close future for GERB

- The MSG-1 satellite was successfully launched on 28 August 2002.
- Now on the geostationary orbit over Atlantic Ocean, going to its commissioning position ($10.5^{\circ}W$).
- Second half of October 2002: first SEVIRI and GERB images
- Commissioning period: the GERB data will be processed using Meteosat-7 as imager
- September 2003: start of routine operations for MSG-1 at 0° .

Data Processing Flow Chart



3 Main Processings

1. Imager Processing (10*10 km res):

- Estimation of BB filtered and unfiltered radiances (NB-to-BB conversions),
- Scene identification,
- Estimation of the BB unfiltered fluxes.

2. GERB processing

- Comparison GERB measurement L_{sw} /imager estimation L'_{sw}

$$C_{sw} = \frac{L_{sw}}{L'_{sw}} \quad C_{lw} = \frac{L_{lw}}{L'_{lw}}$$

- Apply C to the BB unfiltered radiances and fluxes

3. Resolution enhancement

- Expand the C_{sw} and C_{lw} factors from the GERB to the imager spatial resolution. Apply these factors.

GERB Unfiltering

Method:

$$L_{sol} = \left(\frac{L_{sw}}{L'_{sw}} \right) L'_{sol} = \left(\frac{L'_{sol}}{L'_{sw}} \right) L_{sw}$$

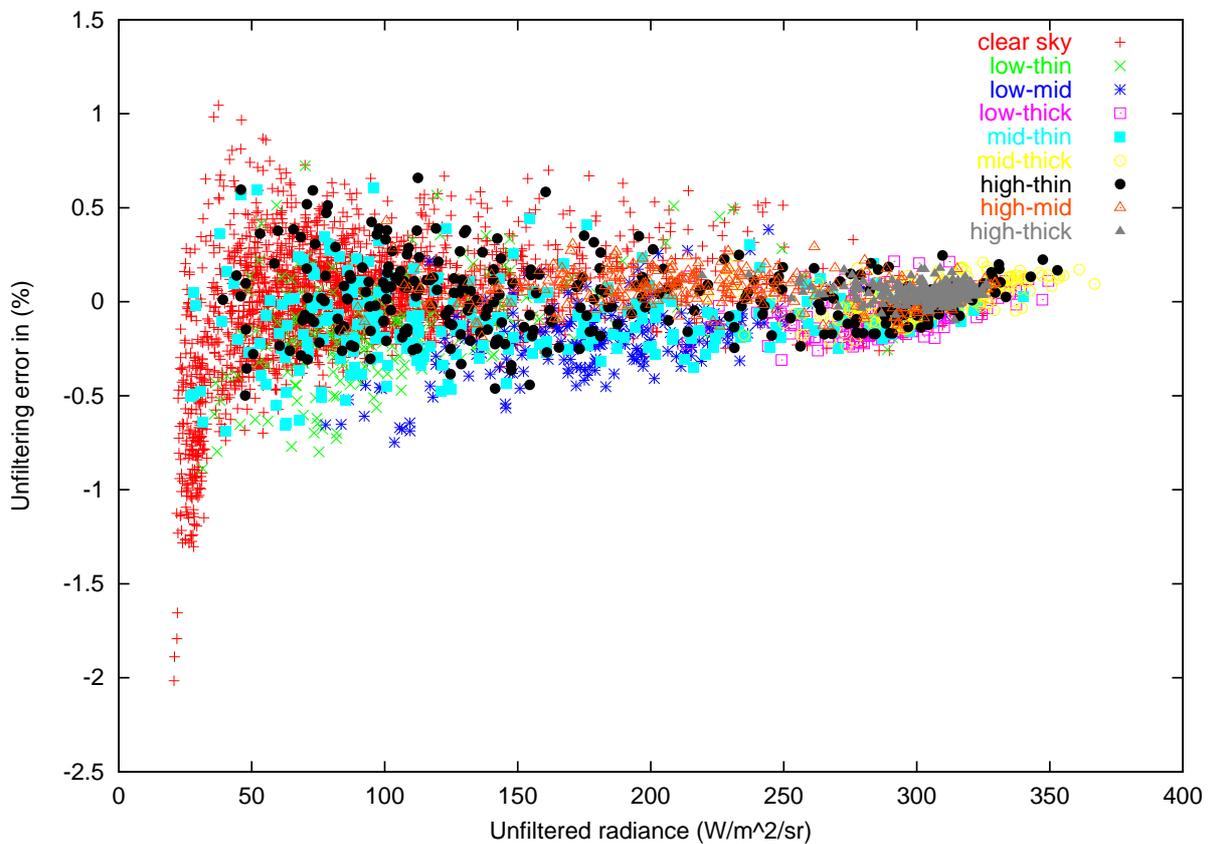
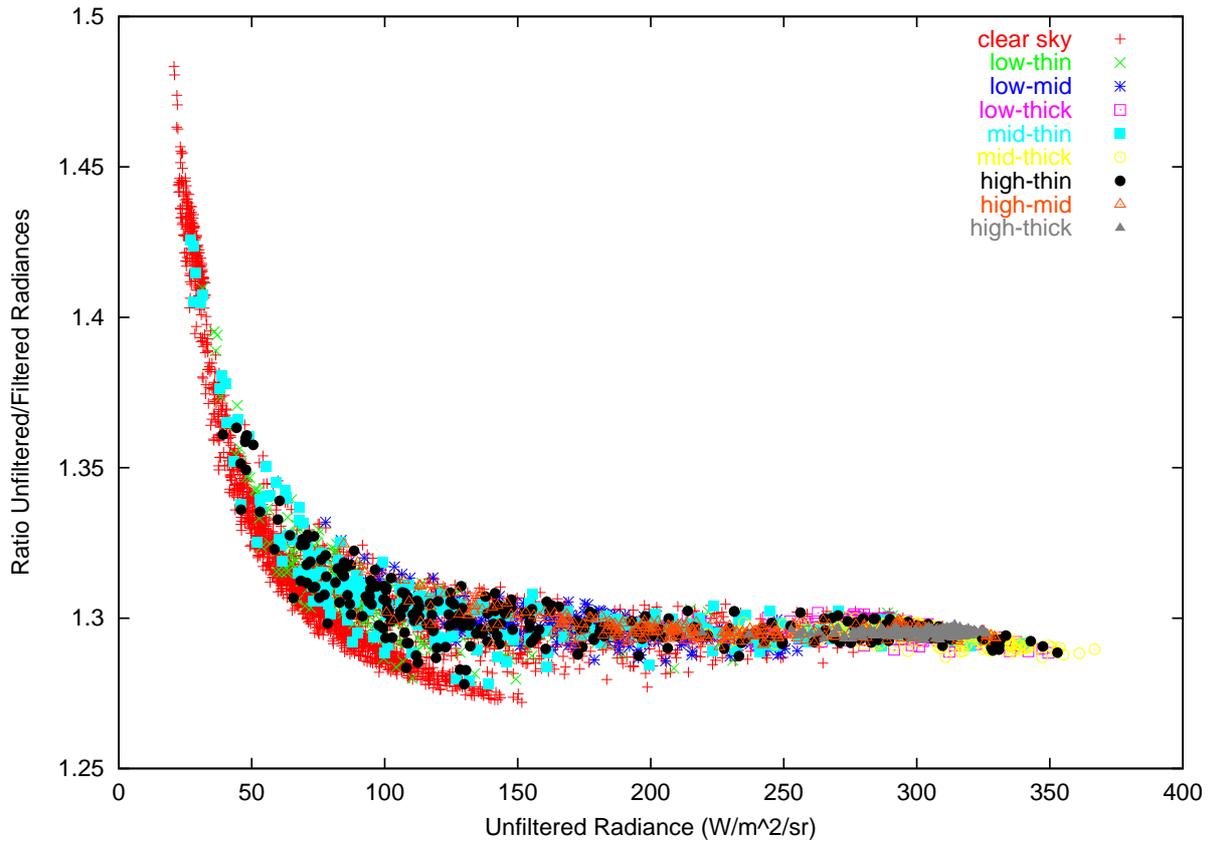
where:

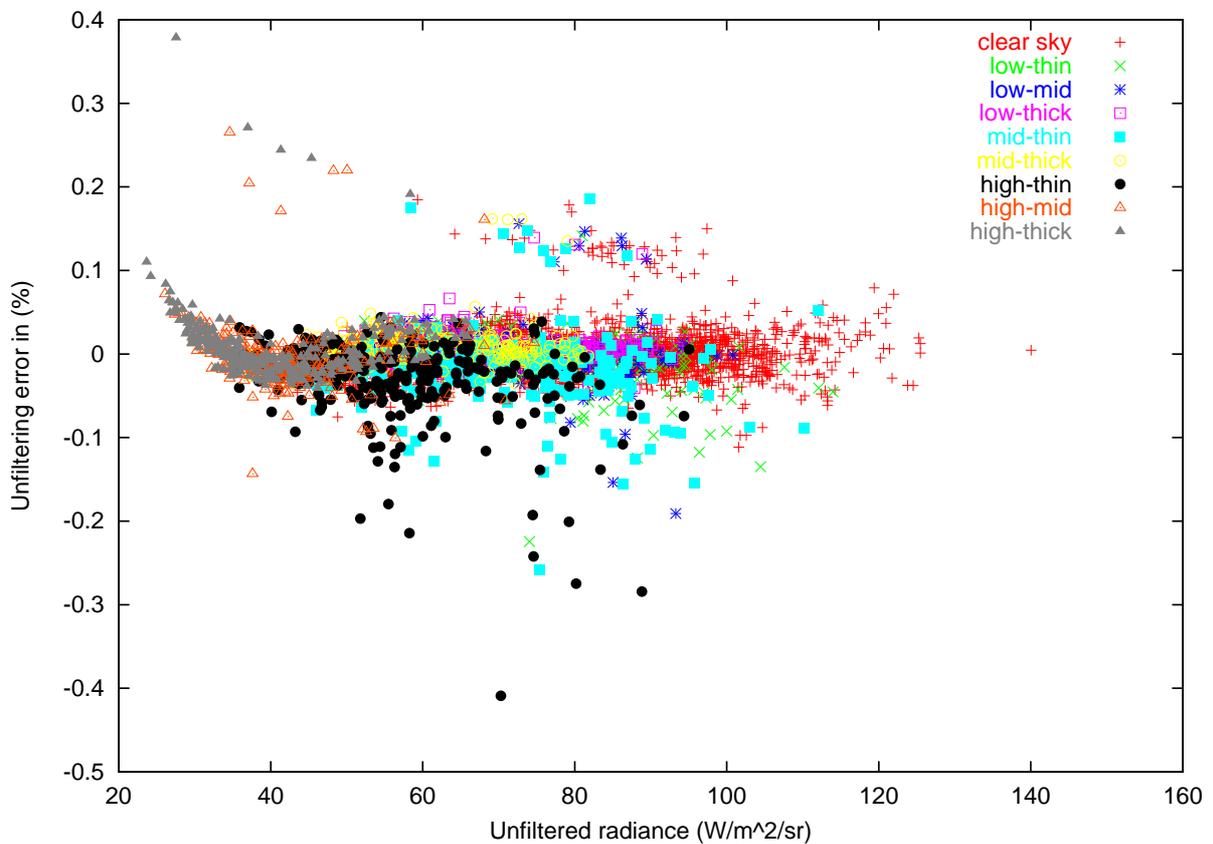
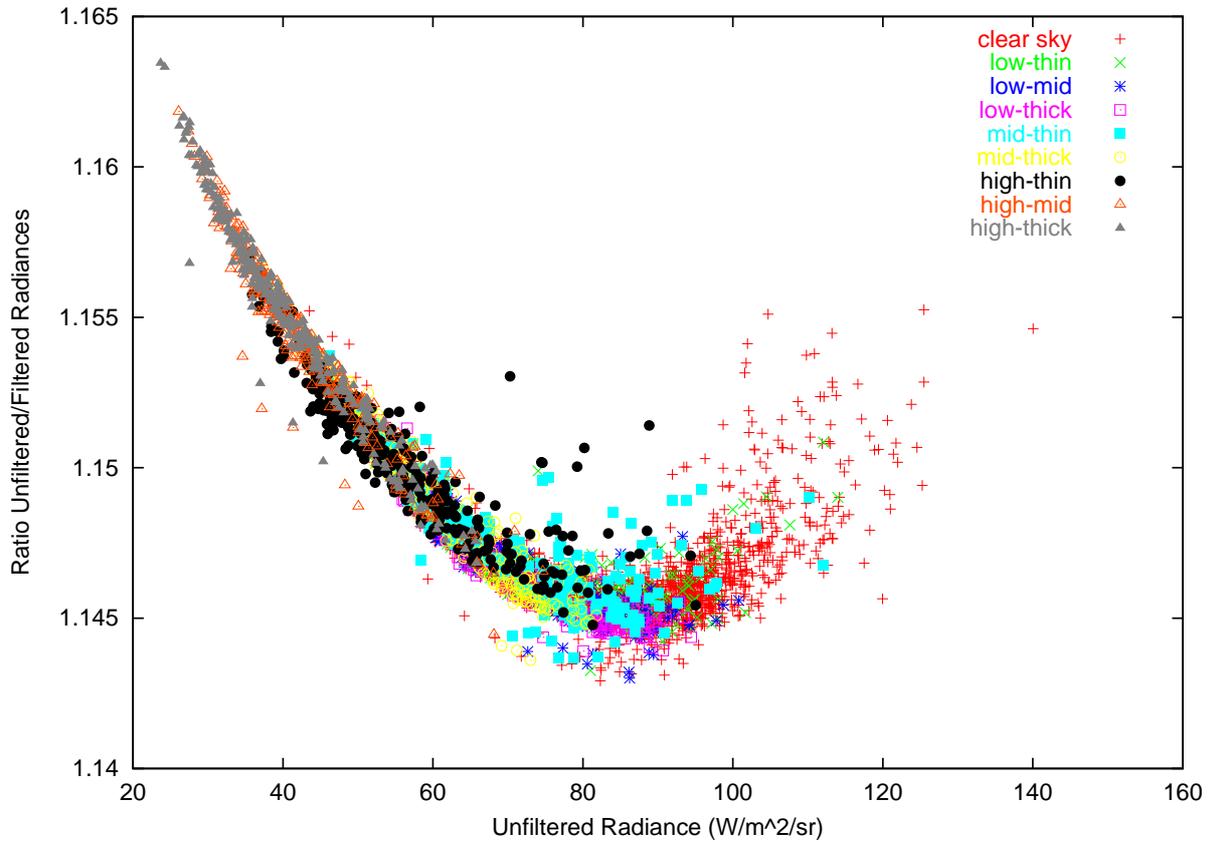
- L_{sw} is the GERB measurement,
- L'_{sol} and L'_{sw} are estimated from SEVIRI by standard NB-to-BB conversions (regressions). Parameterization using a spectral radiance database (RTM). NB-to-BB error (1σ):

BB quantities	SEVIRI 1th order	SEVIRI 2nd order
L_{sol} and L_{sw}	5.1%	4.7%
L_{th} and L_{lw}	1.4%	1.0%

Mean relative error introduced by unfiltering (TN-0034):

$$\begin{aligned} SW & : 0.3\% \\ LW & : 0.1\% \end{aligned}$$





Scene identification on SEVIRI

- Implementation of a “visible clear sky reflectance” algorithm using the previous 60 measurements for the same hour:

$$\rho_{cs}(x, y) = A(x, y) R(\theta_v, \theta_s, \phi)$$

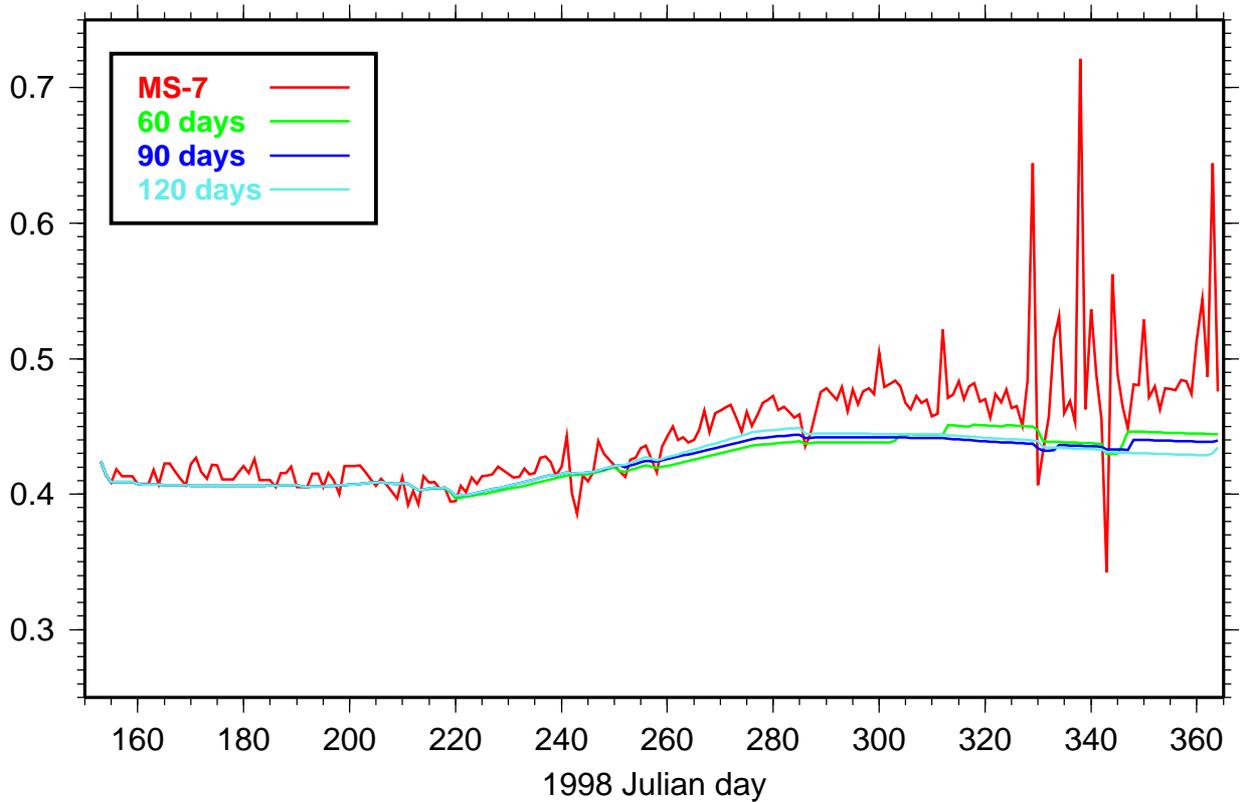
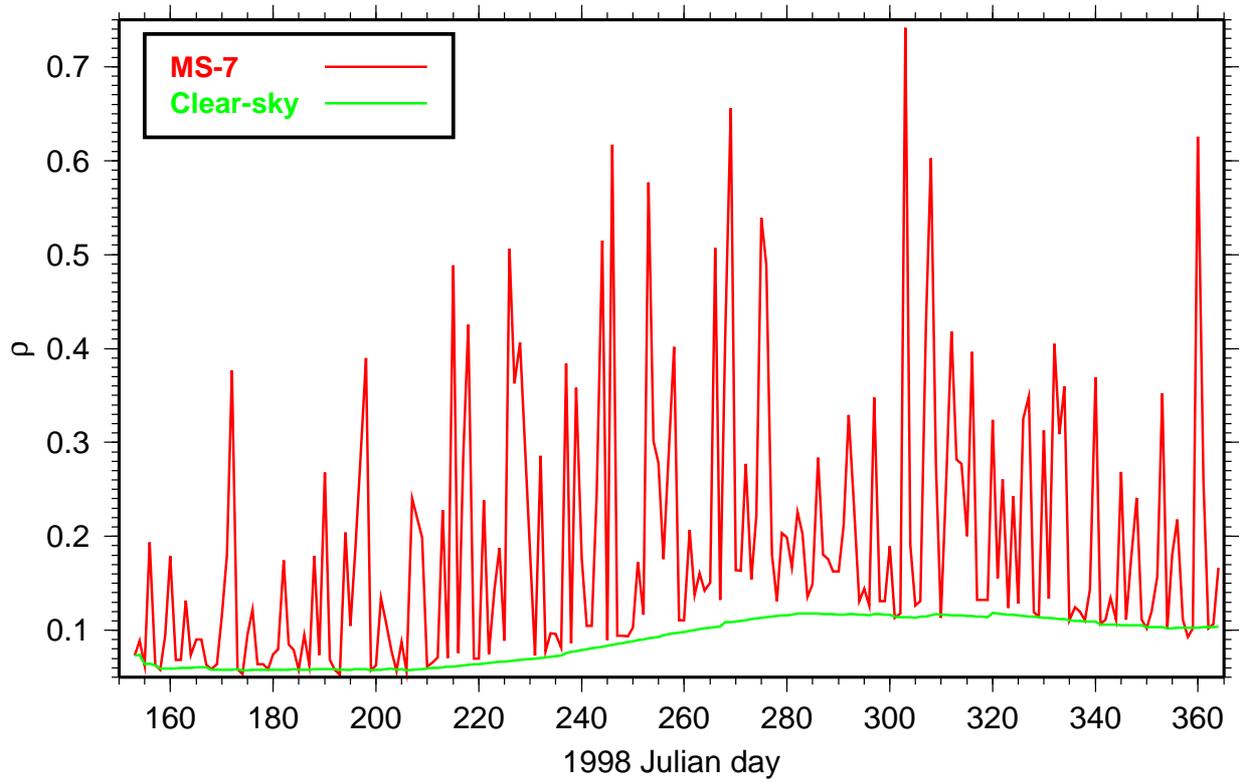
- Estimation of “cloud amount” in a pixel as:

$$C = \frac{\rho - \rho_{cs}}{\rho_{over} - \rho_{cs}}$$

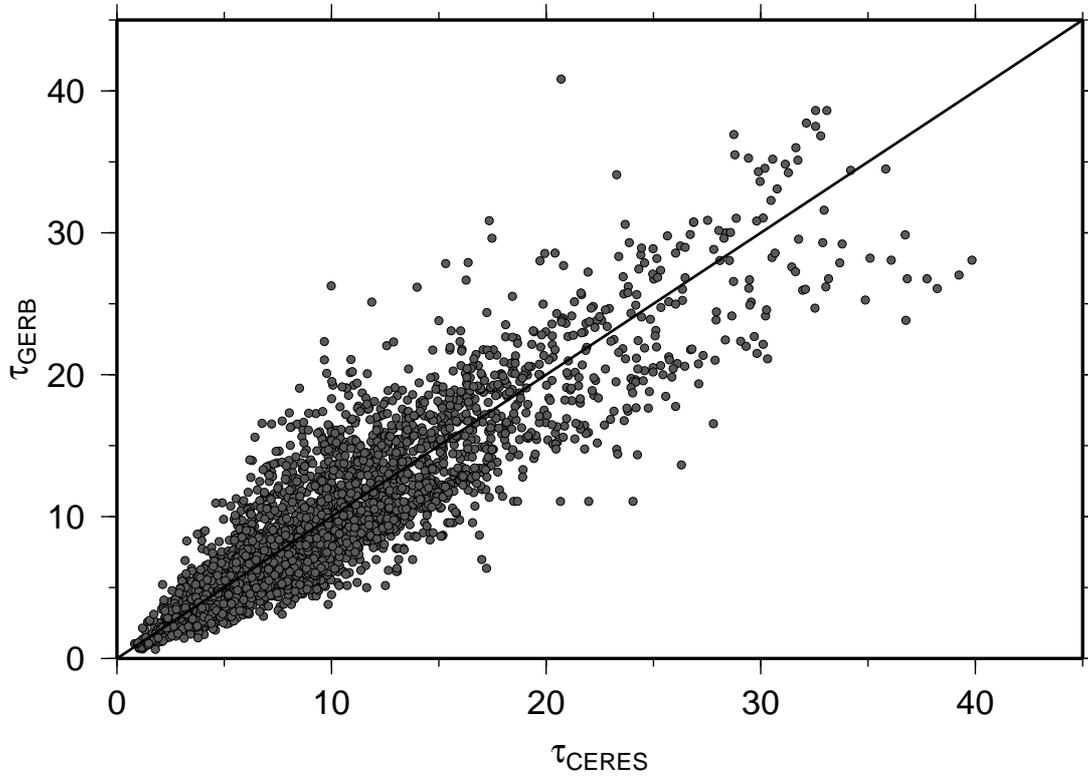
- Look Up Table (STREAMER)

$$\tau = \tau(C, phase, surf, \theta_v, \theta_s, \phi)$$

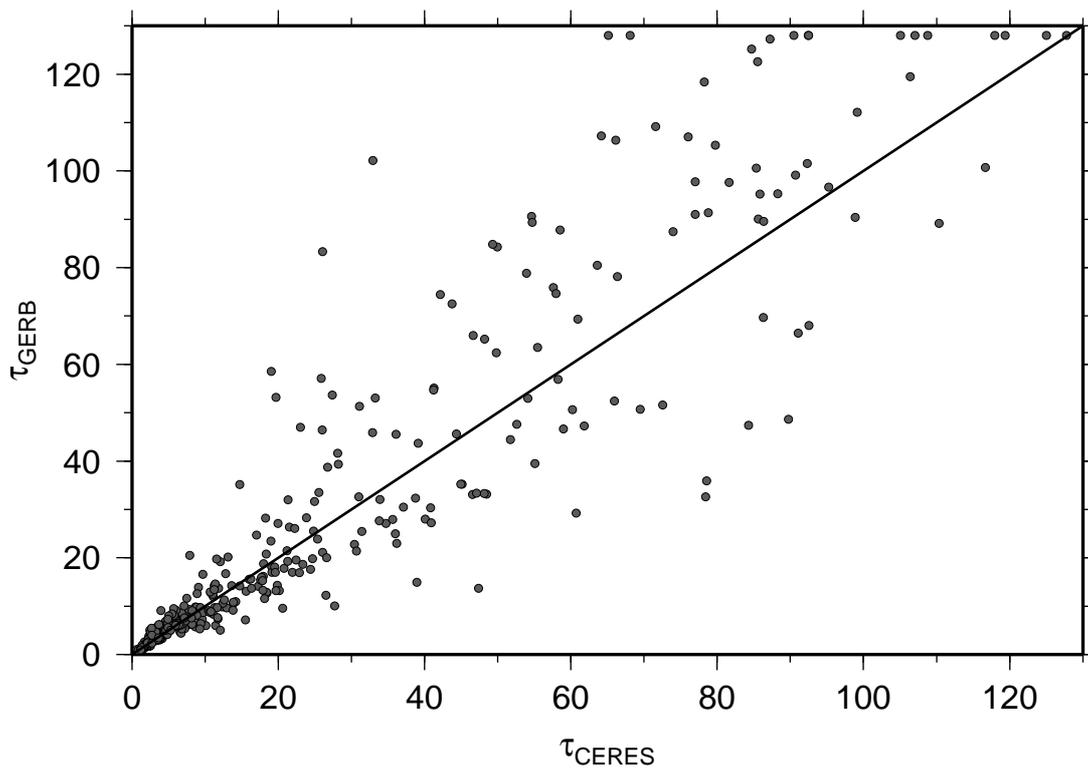
- Thresholding at $\tau_{th} = 0.6$ leads to similar cloud fraction than “CERES-VIRS”
- Phase from $L_{10.8\mu m}$ and ratio $L_{1.6\mu m}/L_{0.8\mu m}$ (Nakajima)



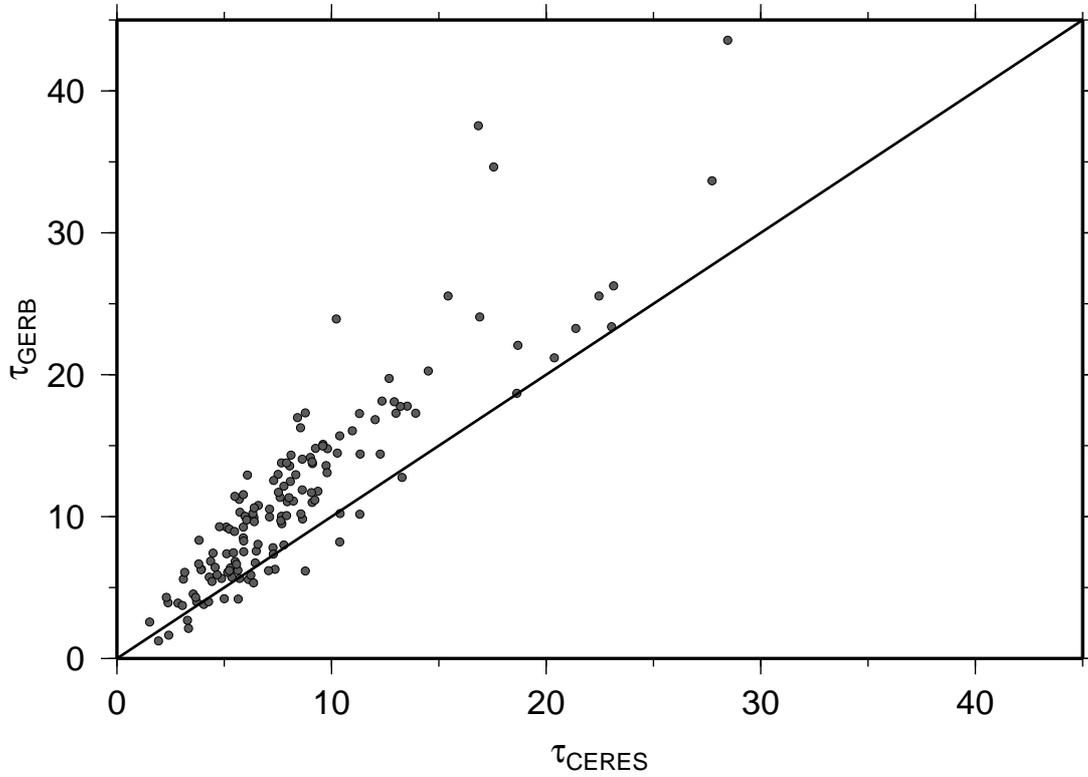
Ocean with water clouds



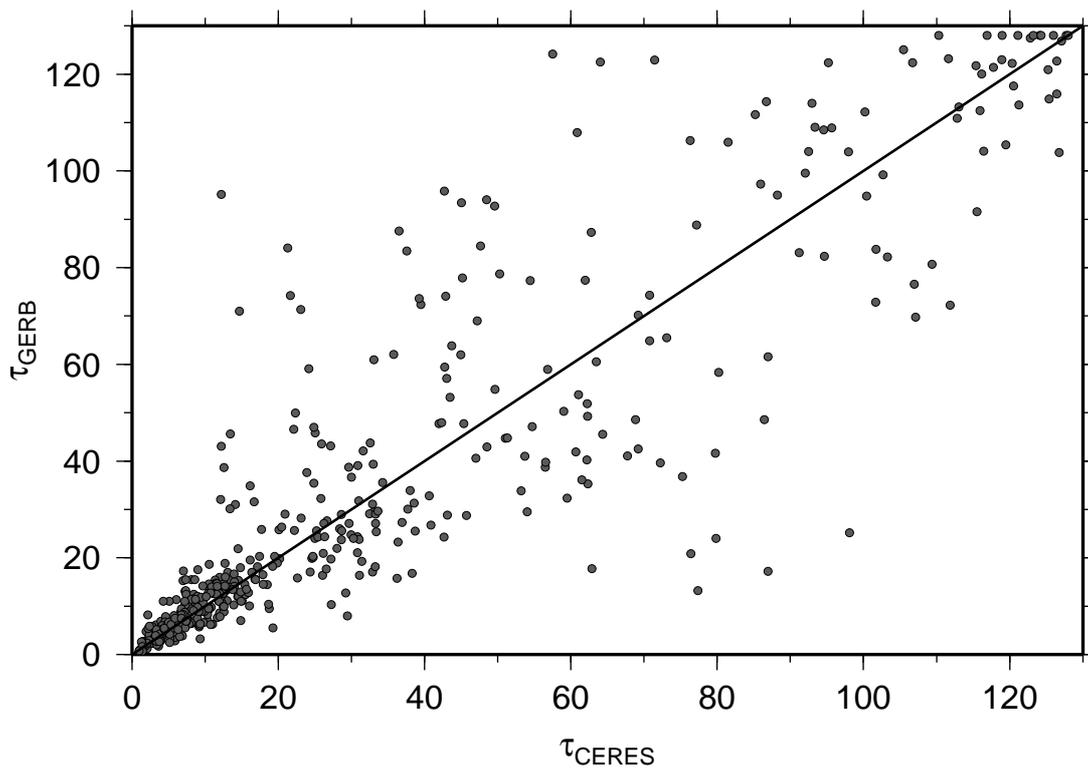
Ocean with ice clouds

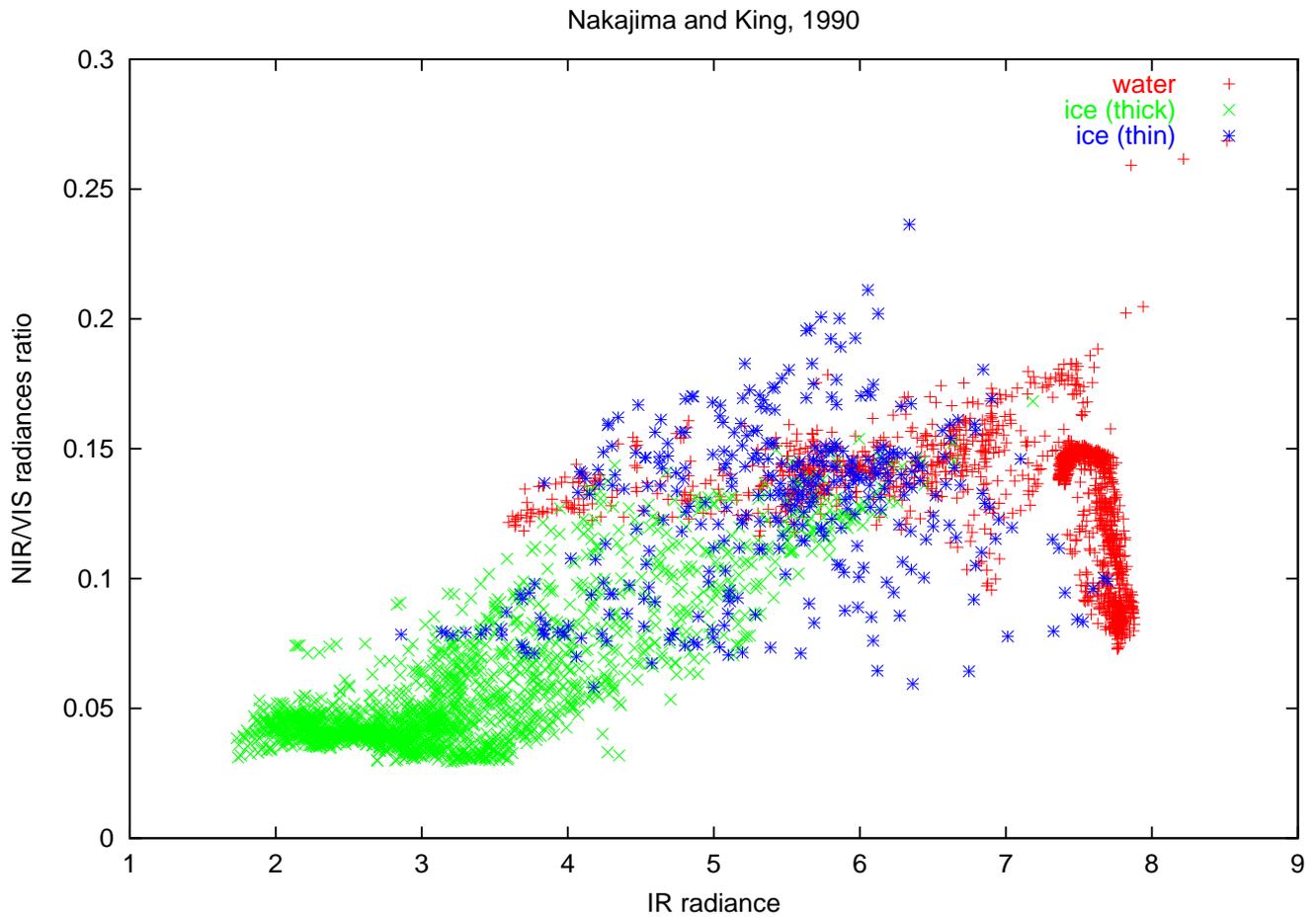


Vegetation with water clouds



Vegetation with ice clouds





Radiance-to-flux

- Shortwave: CERES-TRMM models (implemented),
- Longwave: “spectral model”

$$R = R(\theta_v, L_{6.2\mu m}, \dots, L_{13.4\mu m})$$

- Validation using colocated CERES data

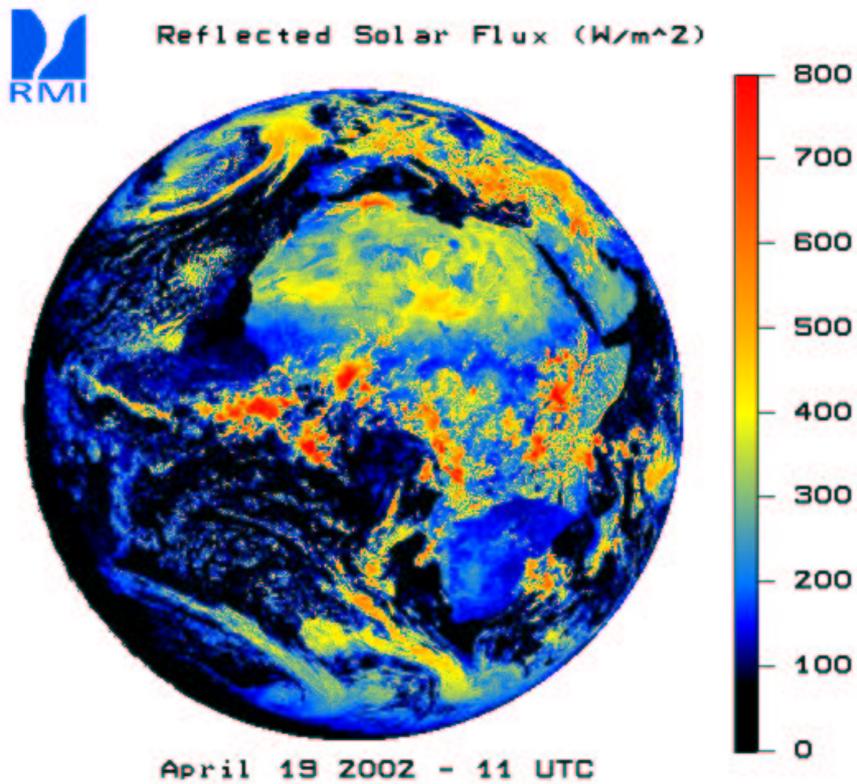
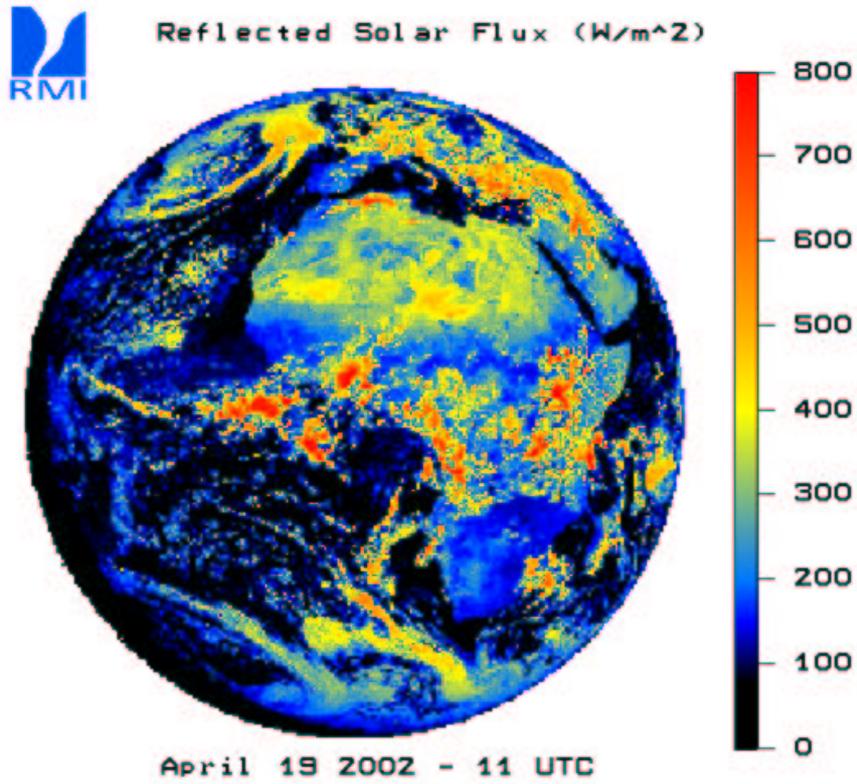
Resolution Enhancement

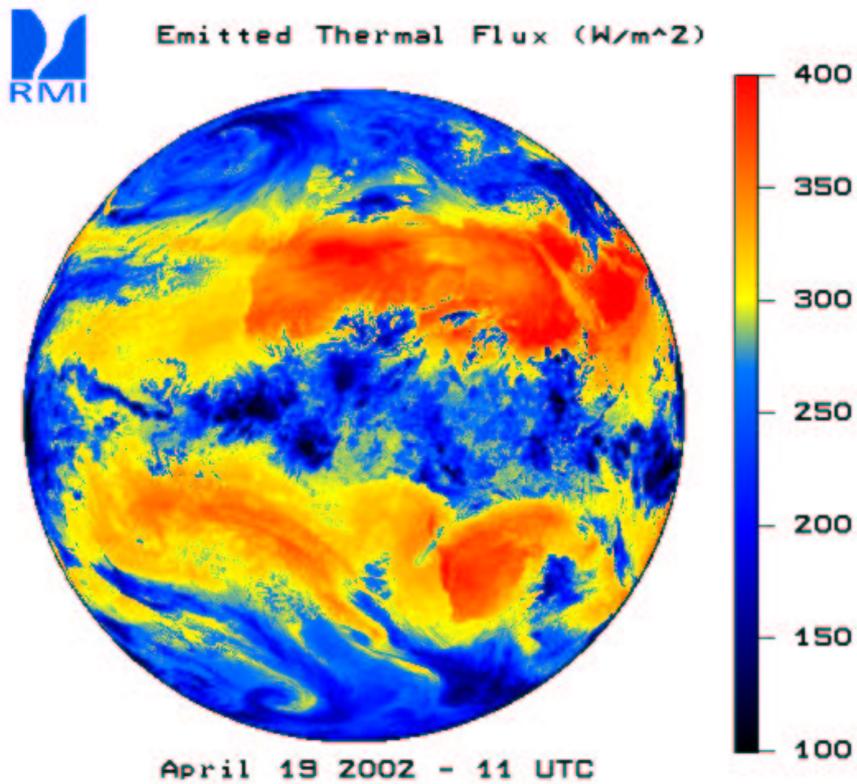
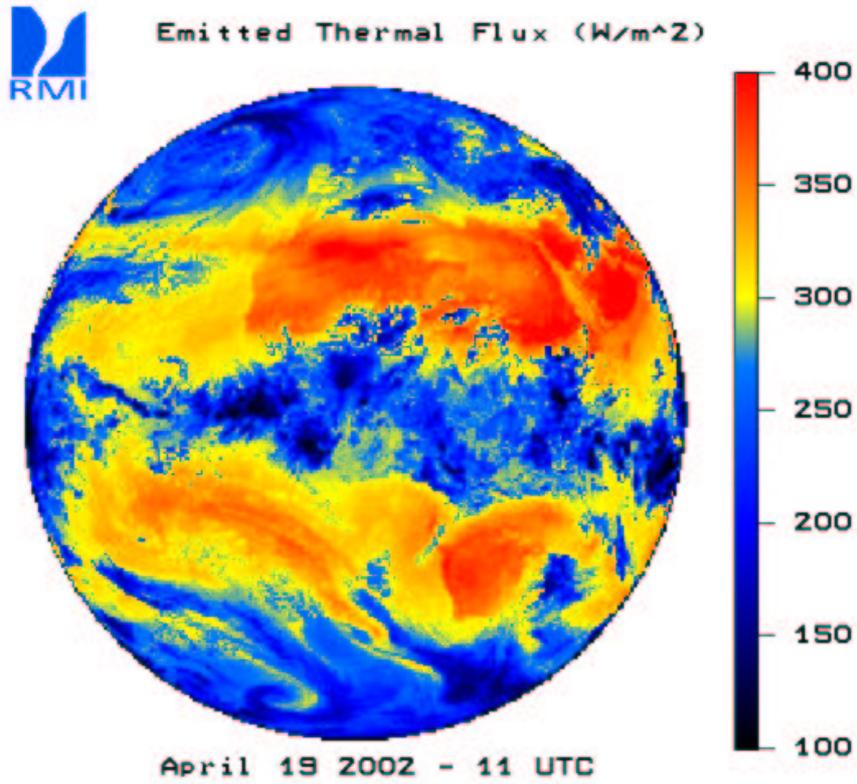
Goal: expand the C_{sw} and C_{lw} factors from the GERB footprint resolution to the imager spatial resolution $\rightarrow c_{sw}$ and c_{lw} .

Method: find the smoothest spatial variations of c_{sw} and c_{lw} with the constraints

$$F = \int_{footprint} PSF(x, y) c(x, y) F'(x, y) dx dy$$

The convolutions of the corrected high resolution fluxes $c(x, y) F'(x, y)$ with the GERB PSF should provide the GERB fluxes.





Conclusions

- Implementation “as simple as possible”,
- Use knowledge from ERBE and CERES experiments (e.g. CERES-TRMM models for SW),
- There remain some missing algorithms/models that will be implemented during the SEVIRI commissioning: fresh snow detection, snow/ice ADM, cloud phase for optically thin cloud, ...
- Some parts of the processing need further “research and/or validation” before being implemented in the real time processing (e.g. thermal anisotropy for thin and high cloud, longwave azimuthal anisotropy).